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AUTHOR Bentz, Darrell; Szymczuk, Mike
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ABSTRACT

A study was designed to investigate the auditory-visual integrative abilities of primary grade children for five long vowels and five short vowels. The Vowel Integration Test (VIT), composed of 35 nonsense words having all the long and short vowel sounds, was administered to students in 64 schools over a period of two years. Students' indications of the vowel sounds they heard were recorded along with information regarding the test form, school district size, school's percentage of students enrolled in Title I programs, type of reading program, grade level, and subject's sex. The results revealed that the long vowel sound and the short vowel sound of "a" and "o" were easily mastered by first grade children. However, the remaining short vowel sounds (e, i, and u) were difficult for children even at the third grade level. The type of reading program was a significant factor, with supportive programs--using both basal and supplementary vowel development materials--showing consistent superiority over phonetic and nonphonetic programs. Sex type and the percentage of Title I students in a school were not significant factors. (RL)

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# The Developmental Process of Vowel Integration As Found in Children in Grades 1-3

Darrell Bentz and Mike Szymczuk

Heartland Education Agency, Ankeny, Iowa

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Running Head: Developmental Process

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# The Developmental Process of Vowel Integration as Found in Children in Grades 1-3

The relationship between letter sounds and their respective symbols is taught in every basal reading series. Some reading series like Lippincott and Economy foster a philosophy that recommends the sound-symbol relationship of letters be taught prior to word identification. Other basal reading series such as Scott Foresman suggest that word recognition be taught first and sound-symbol letter relationships be taught second. This philosophical difference has sparked a controversy among educators that has been debated for many years. The underlying questions of the debate which need to be addressed are "Does the order of instruction make a difference?" and "If so, at what grade level?"

While there is little agreement among reading experts as to an appropriate order of introducing letter sounds and symbols, a number of research studies do indicate that children tend to have more difficulty learning vowel sounds than they do consonant sounds. Experts agree that consonant sounds should be taught before vowel sounds (Durkin, 1970; Langman, 1962; Williams and Knafle, 1977).

To understand the reasons why children have difficulty mastering vowels, a review of the auditory development ladder needs to be explored. A fundamental factor in auditory development is normal hearing. Children with normal hearing move to the second rung of the auditory development ladder, auditory discrimination. At this level children must determine

the likeness or difference among sounds. The final rung involves the associative process, called auditory perception. Myklebust (1954) defines auditory perception as the ability to "structure the auditory world and select those sounds which are immediately pertinent to adjustment." Oliphant (1971) relates auditory perception to reading as the "process of attaching visual meaning to a sound, or associating a sound or group of sounds to a visual stimuli." In her discussion of the integrative process she presents one question that must be answered before children begin phonetic reading, "Can the child listen to a sound or a series of sounds, as in a word, and associate the visual image of the letters which go with the sound in order to read the word?"

This study is designed to investigate the auditory-visual integrative abilities of children in grade levels one, two and three for five long vowels and five short vowels. To facilitate the study the investigators have developed an instrument to measure a child's ability to integrate long and short vowels.

## Method

### Instrument

The Vowel Integration Test (VIT) developed by Bentz and Szymczuk (1979) is designed to measure the phonetic process of vowel integration. Unlike other tests which claim to measure the integrative process, VIT is composed of thirty-five words (three words for each long vowel sound, and four words for each short vowel sound.) Based on the work of Durrell and Murphy (1963) long vowel sounds are more easily perceived

than short vowel sounds. Thus, it is not necessary to have as many words per long vowel sound. Other tests of vowel integration (Botel Reading Inventory, Gates-McKillop Reading Diagnostic Test, and sequence test #5 of the Systematic Approach to Reading Improvement) are often composed of one or two items per vowel sound. These tests may yield ambiguous results of vowel sound mastery.

In addition to the test's length, the items are nonsense words which makes the integrative task auditory dependent. Nonsense words eliminate the possibility of a child recalling the word from a previous visual experience. Another feature of VIT is that the vowel sound is in the middle position of each nonsense word. A vowel in the middle position of a word is among one of the most difficult integrative tasks for children in beginning reading.

There are three forms of the VIT so that a child may be tested with one form and retested with a parallel form. Form 1 and Form 2 are parallel in content. In order to horizontally link Form 1 and Form 2 by the Rasch linear equating technique (Wright, 1979), Form 3 is composed of words from both Form 1 and Form 2.

Sample

In order to sample a representative number of children within Area Education Agency 11 (AEA 11), a list was compiled of all elementary schools. Schools that did not include grade levels one through three were excluded from the list. One hundred and seventy-six schools qualified for the list.

Using an estimate of 20 students per classroom and one classroom per school, the population size for each grade level was approximately 3,520 students. An algorithm derived from Hays (1963) was used to compute the sample size per grade level. It was found that 1,281 students were needed when the probability is approximately 99% that the sample mean falls within 0.05 units of the population mean. With 20 students per classroom, 64 schools were to be included in the sample.

Two ancillary variables of this investigation were school district size and percentage of Title I students within a school building. The 64 schools were divided into three categories based upon their respective district size: 0 to 999 students, 1,000 to 20,000 students and more than 20,000 students. To categorize the schools by their respective amount of Title I students the 64 schools were listed by the percentage of Title I students as reported to the Iowa Department of Public Instruction during the 1978-79 school year. Three classifications best categorized the percentage of Title I students: less than 7%, 7% through 15% and greater than 15%. It should be noted that comparable alternate schools were chosen for those schools who declined to participate.

Insert Table 1 about here

Finally, one classroom of students in grade levels one, two and three from each sampled school was selected to participate. Because

subjects were required to hear oral stimuli, students with impaired hearing were excluded from the sample.

Procedure

Because of the number of sampled schools, testing took two years. Each testing period began at the start of the second semester in late January or early February. The instrument's content required children to identify vowel sounds which are generally introduced at the first grade level in most reading development curricula.

After the sample schools were identified, principals were contacted by phone and invited to participate. Prior to testing a given school, the investigators met with the first, second and third grade teachers to explain the instrument and their role. Only one classroom of first second and third grade children in each school was selected to participate, but often all first, second and third grade classroom teachers asked for and were granted the opportunity to participate.

A test instrument was administered individually to each child by an investigator. To assure anonymity each child was assigned a number by the child's teacher. During testing the identification number was recorded onto the test instrument for future reference. After testing each classroom the investigators conferred with the classroom teacher and used an identification number when referring to a specific child.

When testing a child, the investigator either sat parallel to or across from the child at a table. A card with the vowels A, E,

I, O and U was placed before the child. Recognition of the letters as vowels was required before testing could proceed. After the investigator was confident that the child knew the letters as vowels, the following directions were read to each child.

> *"I am going to say some made-up words. I want you to listen carefully to the sound you hear in the middle of the word and point to the letter on the card that makes that sound. I will say each word twice. Let's practice with a few words so that you will know what to do. If I say the word, 'fab', which vowel would you point to?"*

Thirty-five one syllable nonsense words were read to each child. The investigator recorded the child's response for each word onto the instrument.

Student response data on each test instrument was transferred onto a computer scannable sheet. In addition to the response data, information regarding test form, school's district size category, school's percentage of Title I category, subject's sex, grade level, and reading program were recorded onto the scan sheet.

## Results

### Content Validity

The objectives of behavior for the VIT were defined as the singular long and short vowel sounds. The words for each objective were developed in accordance with the pronunciation guide outlined in Webster's New Collegiate Dictionary (1975).

Criterion Validity

It was felt that teachers were the best judges of student ability to identify vowel sounds. This assumption was most likely appropriate for students in first and second grade where fundamental vowel and sound relationships are taught. The investigators asked twenty-seven first grade teachers, twenty-six second grade teachers, and twenty-six third grade teachers to rate how well their students would perform: above average (no problem with any vowel sound), average (a problem with one vowel sound), and below average (a problem with two or more vowel sounds). The criterion for classifying a student's performance was based upon the curricular introduction of vowel sounds in most basal readers for second grade level children. Thus, it was felt that VIT was most appropriate for second grade children.

A comparison of predicted classification versus teacher classification is shown in Table 2. As expected, a higher percentage of second grade teachers agreed with the VIT results. Approximately eight out of every ten second grade teachers concurred, where as only seven out of ten first and third grade teachers agreed with the predicted VIT results.

Insert Table 2 about here

Reliability

Test reliabilities for the VIT are represented in terms of Guttman's split-half indices (SPSS, 1979). It is based on the assumption that a test consists of two "equivalent" halves. To formulate

the index items are classified by their respective objective or domain and randomly assigned to subtests or halves (Gulliksen, 1950). The split-half indices are reported in Table 3.

Insert Table 3 about here

Item and Objective Analysis

All three forms of the VIT were subjected to an item analysis through a locally developed computer program. A review of the items revealed that two items, as suspected by the investigators, should be replaced. A short "e" sounding item and a long "u" sounding item shared by Form 2 and Form 3 tended to confuse respondents. Approximately 25 percent of the students responding to the short "e" sounding item acknowledged it as an "i" sound. Similarly, 30 percent of the students responded to the "u" sound as an "o" sound. These items were excluded from the final computation of the objectives' average percent correct and the computation of the test reliability indices.

Table 4 illustrates the average percent correct for each objective by grade level and test form. The developmental process of vowel integration is clearly shown in Figure 1. In Figure 1, each bar or column represents the average percent correct for each vowel sound by grade level across the three forms.

Insert Table 4 and Figure 1 about here

Statistical Analysis

The unit of observation for the statistical analyses was the classroom mean rather than the individual student response. It was felt

that the classroom mean was least biased by instruction. In other words, the units of observation were statistically independent. Further, the sampling distribution of means is defined by the central limit theorem as asymptotically normal. Hence, usage of the ANOVA was considered appropriate for the sample of objective or domain means and the composite mean.

A four-way ANOVA was computed for each objective and the composite on the pooled sample of means from forms one, two and three. The sources of variation for the ANOVAs were grade level, sex, building's district size and percentage of students eligible for Title 1. Utilizing the ANOVA subroutine within SPSS the resulting F-values for the completely randomized factorial design revealed that the grade level main effect as expected, was statistically significant for each objective and the composite. However, it was also found that the size factor was statistically significant for each objective and the composite ($p > .01$). The size main effect means and standard deviations for each objective and the composite are listed in Table 5.

Insert Table 5 about here

Other sources of variation, sex and the percentage of Title 1 was significant for the long "u" objective and the short "a" objective. While both objectives were significant at the .01 probability level, no clear reason for their significance was discerned.

Another variable that was identified, classified and recorded

for each participating school was the type of reading program. For classification purposes, a supportive program utilized both a basal and supplementary vowel development material. A phonetic program used only a basal which stressed vowel development in first grade and a non-phonetic program subscribed to a basal with word identification prior to vowel development. Because this variable was not completely distributed among all the levels of size and percentage of Title 1, a three-way ANOVA was computed for each objective and the composite. For each ANOVA the sources of variation were program, grade level and sex.

The results of the ANOVAs revealed that program and grade were statistically significant for each objective and the composite ($p < .01$). Again, the sex source of variation was not statistically significant for any objectives. In Table 6, the means and standard deviations are reported for each objective and the composite by program.

Insert Table 6 about here

In order to further investigate how program and grade interact, the F-ratios for the program by grade interaction effect were statistically significant for several objectives and the composite. Figure 2 illustrated the relationship between grade and program for the composite score.

Insert Figure 2 about here

## Discussion

The results of the Vowel Integration Project (VIP) have revealed several qualities about vowel development in children for grade levels one, two and three. First, boys and girls do equally well when integrating vowel sounds. Neither sex has an advantage for any given vowel sound. Secondly, children appear to easily master the long vowel sounds and the short vowel sounds of "a" and "o". However, the three remaining short vowel sounds tend to be a nemesis to children even into the third grade, for example, only 81 percent of the third graders correctly responded to the short "u" sounding vowel words. This finding suggests that teachers need to focus more attention on the development of the short "e", "i" and "u" vowel sounds, and less attention on the development of the long vowel sounds and of the short vowel sounds, "a" and "o". Finally, integration is in part developmental. This is shown in two ways. First, in Figure 2 first grade children who have had no formal classroom instruction in vowel sounds score an average of 24.47 out of a possible 35 correct responses. Secondly, Figure 2 also illustrates that the average growth between second and third grade is approximately the same for children in supportive phonetic and non-phonetic reading programs. Children without direct instruction in a given vowel sound develop their integrative skills through either usage or exposure to similar tasks.

In addition to observing children, this investigation studied the potential effects of Title 1, district size and reading program. It found that schools with a high percentage of students eligible for Title 1 do as well as schools with none or few students eligible for Title 1. In part, this may be due to the efforts of Title 1 teachers and special reading teachers. Perhaps as Title 1 funds are reduced and both special teachers and Title 1 teachers are dismissed, the effects of the percentage of Title 1 students may become more prominent.

Two variables, district size and reading program, are found to be significant factors. However, the statistical significance of size is confounded with reading program. Schools of medium size, 1,000 - 20,000, generally utilize a supportive program. Table 7 illustrates the proportion of schools using the various classified programs. Hence, the statistical significance of size may be reflecting reading program more than size itself.

Insert Table 7 about here

It appears that the type of reading program is a key factor in the development of vowel integration. As shown in Table 6 the supportive program is consistently superior for each vowel sound and the composite. This is further illustrated in Figure 2. It shows that children in a supportive program start and remain better at identifying vowel sounds than either those children in phonetic or non-phonetic basals. However, Figure 2 also dramatically reveals that second and third grade

students in non-phonetic programs do slightly better than students in phonic programs. Students in non-phonetic reading programs exhibit great growth between first and second grade.

One possible explanation as to why the supportive program does better may be that teachers spend more time on vowel development and use multiple resources. For example, one school district allots one-half hour daily and utilizes a program that matches a vowel sound to its visual symbol. In addition, this program has a heavy emphasis on drill and practice.

Still many questions remain unanswered. Does vowel development transfer to spelling or reading? Are children who cannot integrate vowel sounds poor spellers or poor readers? At what grade level does literary context compensate for poor decoding skills or does it ever do so? These and other questions need to be researched in order to better understand the relationship of vowel development and various academic skills.

Table 1

Distribution of Schools Across

District Size and Percentage of

Title I Students in Schools

| | District Size | | |
|---|---|---|---|
| % of Title I | 0 - 999 | 1,000 - 20,000 | > 20,000 |
| 0 - 7 | 2 (2) | 9 (10) | 2 (1) |
| > 7 - 15 | 6 (6) | 12 (12) | 3 (4) |
| > 15 | 12 (11) | 9 (7) | 9 (10) |

( ) *figures in parenthesis represent the actual number of schools contacted by researchers*

Table 2

Average Percent of Agreement

Between Teacher Judgement and

VIT Predictions

| | Form | | |
|---|---|---|---|
| Grade | 1 | 2 | 3 |
| 1 | 68 | 78 | 72 |
| 2 | 71 | 76 | 83 |
| 3 | 67 | 64 | 75 |

Table 3

Guttman Split-Half Indices

for the VIT by

Grade Level and Form

| Grade | Form | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| 1 | .90 | .93 | .93 |
| 2 | .77 | .91 | .85 |
| 3 | .77 | .90 | .82 |

Table 4

Average Percent Correct for Each Objective
by Form and Grade Level

| Form | Vowel | Grade 1 | Grade 2 | Grade 3 |
|---|---|---|---|---|
| 1 | Long A | 87 | 92 | 94 |
| | Long E | 90 | 95 | 96 |
| | Long I | 90 | 97 | 97 |
| | Long O | 93 | 97 | 97 |
| | Long U | 79 | 90 | 92 |
| | Short A | 87 | 93 | 94 |
| | Short E | 70 | 83 | 86 |
| | Short I | 69 | 82 | 85 |
| | Short O | 81 | 92 | 92 |
| | Short U | 62 | 77 | 81 |
| 2 | Long A | 90 | 95 | 96 |
| | Long E | 91 | 96 | 98 |
| | Long I | 89 | 96 | 97 |
| | Long O | 94 | 98 | 98 |
| | Long U | 80 | 92 | 93 |
| | Short A | 90 | 97 | 97 |
| | Short E | 74 | 87 | 89 |
| | Short I | 63 | 79 | 83 |
| | Short O | 80 | 90 | 91 |
| | Short U | 61 | 77 | 79 |
| 3 | Long A | 89 | 95 | 95 |
| | Long E | 89 | 95 | 96 |
| | Long I | 91 | 97 | 98 |
| | Long O | 91 | 97 | 97 |
| | Long U | 83 | 92 | 94 |
| | Short A | 88 | 95 | 96 |
| | Short E | 74 | 85 | 86 |
| | Short I | 69 | 83 | 87 |
| | Short O | 83 | 93 | 92 |
| | Short U | 67 | 81 | 84 |

Table 5

Means and Standard Deviation for Each

Objective and the Composite

by Building's District Size

| | District Size | | | | | |
|---|---|---|---|---|---|---|
| | 0 - 999 | | 1,000 - 20,000 | | > 20,000 | |
| Vowel | *Mean* | *S.D.* | *Mean* | *S.D.* | *Mean* | *S.D.* |
| Long A | 2.71 | .26 | 2.82 | .20 | 2.76 | .29 |
| Long E | 2.78 | .19 | 2.88 | .16 | 2.79 | .28 |
| Long I | 2.82 | .23 | 2.88 | .18 | 2.77 | .28 |
| Long O | 2.85 | .18 | 2.90 | .16 | 2.86 | .22 |
| Long U | 1.48* | .62 | 1.83 | .17 | 1.74 | .22 |
| Short A | 3.13 | .73 | 3.67 | .40 | 2.19 | .40 |
| Short E | 1.92** | .53 | 2.67 | .50 | 2.25 | .57 |
| Short I | 2.40 | .68 | 3.01 | .61 | 2.88 | .63 |
| Short O | 3.49 | .52 | 3.61 | .36 | 3.44 | .57 |
| Short U | 2.91 | .77 | 3.16 | .65 | 2.74 | .73 |
| Composite | 26.50 | 3.17 | 29.24 | 2.54 | 27.94 | 3.52 |

* - does not include one long "u" sounding nonsense word
(see Item and Objective Analysis)

** - does not include one short "e" sounding nonsense word

Table 6

Means and Standard Deviations for

Objectives and the Composite by Program

| Vowel | Phonetic Mean | Phonetic S.D. | Supportive Mean | Supportive S.D. | Non-Phonetic Mean | Non-Phonetic S.D. |
|---|---|---|---|---|---|---|
| Long A | 2.66 | .32 | 2.82 | .21 | 2.77 | .24 |
| Long E | 2.80 | .21 | 2.87 | .19 | 2.81 | .21 |
| Long I | 2.85 | .19 | 2.88 | .20 | 2.81 | .25 |
| Long O | 2.83 | .19 | 2.90 | .16 | 2.87 | .19 |
| Long U | 1.57* | .59 | 1.84 | .17 | 1.66 | .42 |
| Short A | 3.17 | .71 | 3.72 | .32 | 3.48 | .60 |
| Short E | 2.26** | .56 | 2.47 | .45 | 2.09 | .60 |
| Short I | 2.73 | .56 | 3.06 | .62 | 2.64 | .71 |
| Short O | 3.62 | .30 | 3.63 | .40 | 3.44 | .54 |
| Short U | 3.07 | .74 | 3.21 | .63 | 2.81 | .74 |
| Total Composite | 27.57 | 2.70 | 29.40 | 2.63 | 27.41 | 3.45 |

* - does not include one "u" sounding word

** - does not include one "e" sounding word

Table 7

Proportion of School

and

Reading Program Overlap

| District Size | Reading Program | | |
|---|---|---|---|
| | Phonetic | Supportive | Non-Phonetic |
| 0 - 999 | 26[a](50)[b] | 10 (9) | 64 (38) |
| 10,000 - 20,000 | 18 (50) | 52 (72) | 30 (27) |
| > 20,000 | 0 (0) | 26 (19) | 74 (35) |

a - numbers not in parenthesis are row percents

b - numbers in parenthesis are column percents

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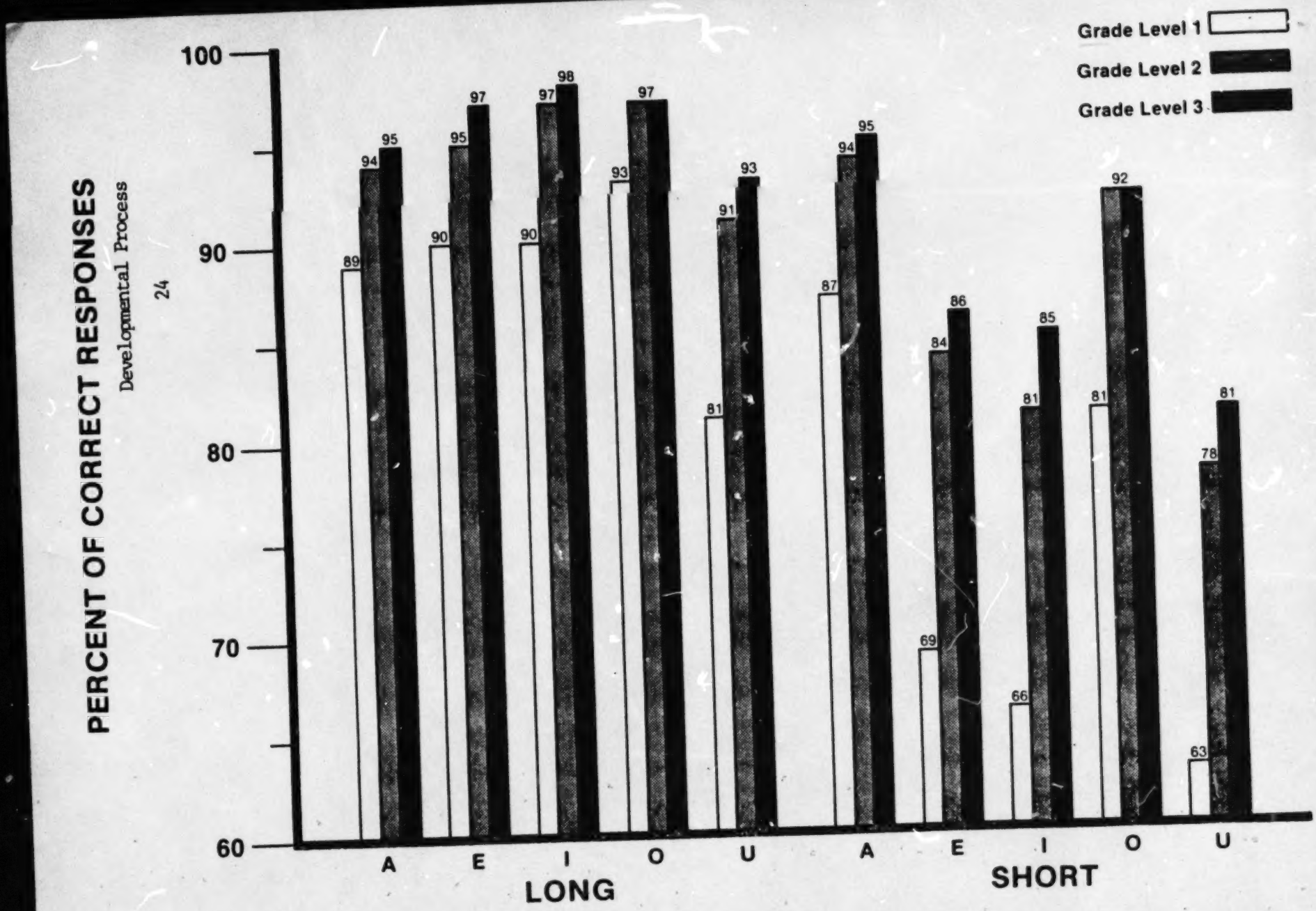
## Figure Captions

Figure 1. Percent of correct responses for vowel sounds by grade levels 1, 2 and 3.

Figure 2. A plot of means for reading programs by grade levels on the VIT composite score.


Grade Level 1
Grade Level 2
Grade Level 3
PERCENT OF CORRECT RESPONSES
Developmental Process
24
100
90
80
70
60
89
94
95
90
95
97
90
97
98
93
97
81
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93
87
94
95
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92
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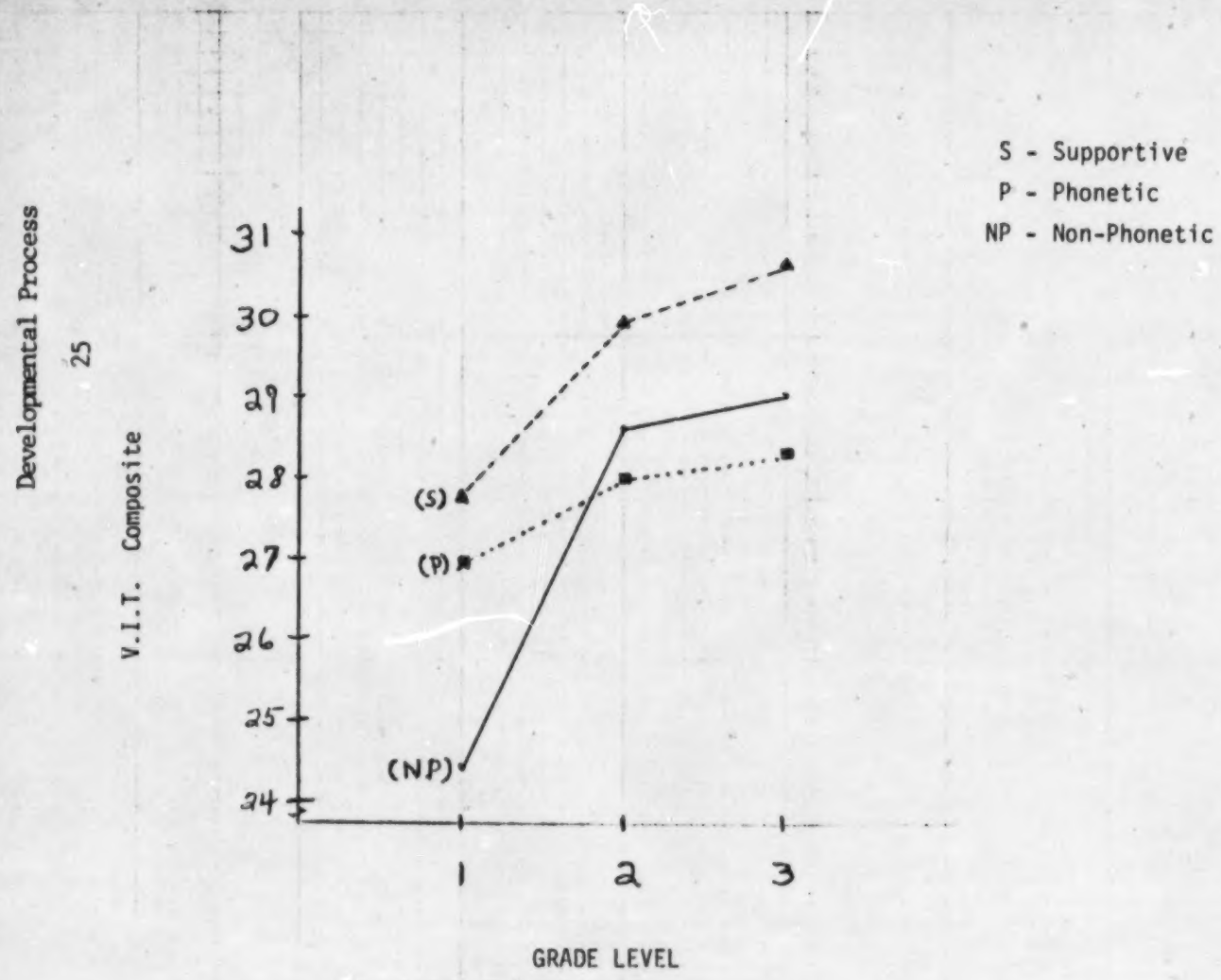
81
A E I O U
LONG
A E I O U
SHORT

25

26


S - Supportive
P - Phonetic
NP - Non-Phonetic
Developmental Process
25
V.I.T. Composite
31
30
29
28
27
26
25
24
(S)
(P)
(NP)
1
2
3
GRADE LEVEL